

WHAT IS CLAIMED IS:

1. A semiconductor manufacturing apparatus for processing a semiconductor wafer, comprising:
  - a unit for generating a plasma in a vacuum chamber;
  - a wafer stage for holding a semiconductor wafer introduced into said vacuum chamber;
  - a high frequency power supply for applying a high frequency voltage to said wafer stage;
  - a wafer voltage probe for measuring a voltage of the semiconductor wafer at a rear surface of said semiconductor wafer;
  - a current and voltage probe for measuring at least one of a voltage and a current applied to said wafer stage from said high frequency power supply;
  - a calculating portion for obtaining an impedance from said semiconductor wafer to earth through the plasma on the basis of a voltage value measured by said wafer voltage probe, and a voltage value or a current value measured by said current and voltage probe; and
  - a processing portion for performing a processing on the basis of the obtained impedance.
2. A semiconductor manufacturing apparatus according to claim 1, wherein
  - said processing portion displays the obtained impedance on a display portion.
3. A semiconductor manufacturing apparatus

according to claim 1, wherein

said processing portion controls various processing parameters on the basis of the obtained impedance.

4. A semiconductor manufacturing apparatus according to claim 3, wherein

said processing portion regards the obtained impedance as an impedance from said semiconductor wafer to an inner wall of said vacuum chamber through the plasma, and controls various parameters on the basis of the obtained impedance.

5. A semiconductor manufacturing apparatus according to claim 3, wherein

said various parameters include a frequency or power of the high frequency voltage for generating said plasma, or the frequency or power of the high frequency voltage applied to said wafer stage, or a temperature or a temperature distribution of a wall forming said vacuum chamber, or a temperature or a temperature distribution of said semiconductor wafer; or at least any one of a pressure of said vacuum chamber, a kind of gases supplied to said vacuum chamber or a flow rate or a mixture ratio of the gases; or at least one kind of a magnetic field applied to the inside of said vacuum chamber, or an etching time.

6. A semiconductor manufacturing apparatus for processing a semiconductor wafer, comprising:

a unit for generating a plasma in a vacuum

chamber;

a wafer stage for holding a semiconductor wafer introduced into said vacuum chamber;

a high frequency power supply for applying a high frequency voltage to said wafer stage;

a current and voltage probe for measuring a voltage and a current applied to said wafer stage from said high frequency power supply;

a calculating portion for obtaining an impedance at a position of said current and voltage probe on the basis of a voltage value or a current value measured by said current and voltage probe, and arithmetic processing a combined impedance of the obtained impedance and an equivalent circuit model from said current and voltage probe to earth through said wafer stage, said equivalent circuit model being prepared beforehand, thereby to calculate an impedance from said semiconductor wafer to earth through the plasma; and

a processing portion for performing a processing on the basis of the calculated impedance.

7. A semiconductor manufacturing apparatus according to claim 6, wherein

said processing portion displays the calculated impedance on a display portion.

8. A semiconductor manufacturing apparatus according to claim 6, wherein

said processing portion controls various

processing parameters on the basis of the calculated impedance.

9. A semiconductor manufacturing apparatus according to claim 8, wherein

said processing portion regards the calculated impedance as an impedance from said semiconductor wafer to an inner wall of said vacuum chamber through the plasma, and controls various parameters on the basis of the calculated impedance.

10. A semiconductor manufacturing apparatus according to claim 6, wherein

said various parameters include a frequency of the high frequency voltage for generating said plasma or power, or the frequency or power of the high frequency voltage applied to said wafer stage, or a temperature or a temperature distribution of the wall forming said vacuum chamber, or a temperature or a temperature distribution of said semiconductor wafer; or at least any one of a pressure of said vacuum chamber, a kind of gases supplied to said vacuum chamber or a flow rate or a mixture ratio of the gases; or at least one kind of a magnetic field applied to the inside of said vacuum chamber, or an etching time.

11. A semiconductor manufacturing apparatus for processing a semiconductor wafer, comprising:

a unit for generating a plasma in a vacuum chamber;

a wafer stage for holding a semiconductor

wafer introduced into said vacuum chamber;

a high frequency power supply for applying a high frequency voltage to said wafer stage;

a wafer voltage probe for measuring a voltage of the semiconductor wafer at a rear surface of said semiconductor wafer;

a current and voltage probe for measuring at least one of a voltage and a current applied to said wafer stage from a high frequency power supply;

a Film thickness probe for measuring a thickness of a film deposited on an inner wall of said vacuum chamber;

a calculating portion for obtaining a first impedance from said semiconductor wafer to earth through the plasma on the basis of a voltage value of said semiconductor wafer measured by said wafer voltage probe, and a voltage value or a current value measured by said current and voltage probe, and further obtaining a second impedance of said deposited film from a thickness of the film deposited on the inner wall of said vacuum chamber measured by said film thickness probe, and obtaining an impedance of said plasma by using the first and second impedances; and

a processing portion for performing a processing on the basis of at least one of the first impedance and the second impedance.

12. A semiconductor manufacturing apparatus according to claim 11, wherein

said processing portion displays at least one of the first impedance and the second impedance on a display portion.

13. A semiconductor manufacturing apparatus according to claim 11, wherein

said processing portion controls various processing parameters on the basis of at least one of the first impedance and the second impedance.

14. A semiconductor manufacturing apparatus according to claim 13, wherein

said processing portion regards the obtained first impedance as an impedance from said semiconductor wafer to an inner wall of said vacuum chamber through the plasma, and controls various parameters on the basis of the obtained first impedance.

15. A semiconductor manufacturing apparatus for processing a semiconductor wafer, comprising:

a unit for generating a plasma in a vacuum chamber;

a wafer stage for holding a semiconductor wafer introduced into said vacuum chamber;

a high frequency power supply for applying a high frequency voltage to said wafer stage;

a current and voltage probe for measuring at least one of a voltage and a current applied to said wafer stage from said high frequency power supply;

a film thickness probe for measuring a thickness of a film deposited on an inner wall of said

vacuum chamber;

a calculating portion for obtaining a first impedance at a position of said current and voltage probe on the basis of a voltage value or a current value measured by said current and voltage probe, and for obtaining a second impedance of said deposited film from a thickness of the film deposited on the inner wall of said vacuum chamber measured by said film thickness probe, and for arithmetic processing a combined impedance of the first and second impedances and an equivalent circuit model from said current and voltage probe to earth through said wafer stage, thereby to calculate an impedance from said semiconductor wafer to the inner wall of said vacuum chamber through the plasma; and

a processing portion for performing a processing based on the calculated impedance.

16. A semiconductor manufacturing apparatus according to claim 15, wherein

said processing portion displays the calculated impedance on a display portion.

17. A semiconductor manufacturing apparatus according to claim 15, wherein

said processing portion controls various processing parameters on the basis of the calculated impedance.

18. A semiconductor manufacturing apparatus for processing a semiconductor wafer, comprising:

a unit for generating a plasma in a vacuum chamber;

a wafer stage for holding a semiconductor wafer introduced into said vacuum chamber;

a susceptor disposed to surround a periphery of said wafer stage;

a high frequency power supply for applying a high frequency voltage to at least one of said wafer stage and said susceptor;

a wafer voltage probe for measuring a voltage of the semiconductor wafer at a rear surface of said semiconductor wafer;

a current and voltage probe for measuring at least one of a voltage and a current applied to said wafer stage from said high frequency power supply;

a susceptor voltage probe for measuring a voltage of said susceptor;

a calculating portion for obtaining a first impedance from said semiconductor wafer to earth through the plasma on the basis of a voltage value of said semiconductor wafer measured by said wafer voltage probe, a voltage value or a current value measured by said current and voltage probe, and a voltage value measured by said susceptor voltage probe, and for obtaining a second impedance from said susceptor to earth through the plasma; and

a processing portion for performing a processing based on at least one of the first and the



second impedances.

19. A semiconductor manufacturing apparatus according to claim 18, wherein

said processing portion displays at least one of the first and the second impedances on a display portion.

20. A semiconductor manufacturing apparatus according to claim 18, wherein

said processing portion controls various processing parameters on the basis of at least one of the first and the second impedances.

21. A semiconductor manufacturing apparatus according to claim 20, wherein

said processing portion regards the first impedance as an impedance from said semiconductor wafer to an inner wall of said vacuum chamber through the plasma, and controls various parameters on the basis of the first impedance.

22. A semiconductor manufacturing apparatus for processing a semiconductor wafer, comprising:

a unit for generating a plasma in a vacuum chamber;

a wafer stage for holding a semiconductor wafer introduced into said vacuum chamber;

a susceptor disposed to surround a periphery of said wafer stage;

a high frequency power supply for applying a high frequency voltage to at least one of said wafer

stage and said susceptor ;

a wafer voltage probe for measuring a voltage of the semiconductor wafer at a rear surface of said semiconductor wafer;

a current and voltage probe for measuring at least one of a voltage and a current applied to said wafer stage from said high frequency power supply;

a susceptor voltage probe for measuring a voltage of said susceptor;

a film thickness probe for measuring a thickness of a film deposited on an inner wall of said vacuum chamber;

a calculating portion for obtaining a first impedance from said semiconductor wafer to earth through the plasma, and a second impedance from said susceptor to earth through the plasma, on the basis of a voltage value of said semiconductor wafer measured by said wafer voltage probe, a voltage value or a current value measured by said current and voltage probe, and a voltage value measured by said susceptor voltage probe, and for obtaining a third impedance based on a thickness of a film deposited on an inner wall of said vacuum chamber measured by said film thickness probe, and for obtaining a fourth impedance from said wafer surface to the film deposited on the inner wall of said vacuum chamber and a fifth impedance from said susceptor surface to the film deposited on the inner wall of said vacuum chamber by using the first, the

second and the third impedances; and

a processing portion for performing a procession based on at least one of the fourth and the fifth impedances.

23. A semiconductor manufacturing apparatus according to claim 22, wherein

said processing portion displays at least one of the fourth and the fifth impedances on a display portion.

24. A semiconductor manufacturing apparatus according to claim 22, wherein

said processing portion controls various processing parameters on the basis of at least one of the fourth and the fifth impedances

25. A semiconductor manufacturing apparatus according to claim 24, wherein

said processing portion regards the fourth and the fifth impedances as an impedance from said semiconductor wafer to the inner wall of said vacuum chamber through the plasma, and controls various parameters on the basis of the obtained impedance.

26. A semiconductor manufacturing apparatus for processing a semiconductor wafer, comprising:

a unit for generating a plasma in a vacuum chamber;

a wafer stage for holding a semiconductor wafer introduced into said vacuum chamber;

a susceptor disposed to surround a periphery

of said wafer stage;

a high frequency power supply for applying a high frequency voltage to said wafer stage and said susceptor independently;

a wafer voltage probe for measuring a voltage of the semiconductor wafer at a rear surface of said semiconductor wafer;

a current and voltage probe for measuring at least one of a voltage and a current applied to said wafer stage from said high frequency power supply;

a susceptor voltage probe for measuring a voltage of said susceptor;

a control portion for controlling the high frequency voltage applied to said wafer stage and said susceptor on the basis of a voltage value of said semiconductor wafer measured by said wafer voltage probe, a voltage value or a current value measured by said current and voltage probe, and a voltage value measured by said susceptor voltage probe.

27. A method of processing a semiconductor wafer, in a semiconductor manufacturing apparatus including a unit for generating a plasma in a vacuum chamber, a wafer stage for holding a semiconductor wafer introduced into said vacuum chamber, and a high frequency power supply for applying a high frequency voltage to said wafer stage, said method comprising the steps of:

measuring a voltage of the semiconductor

wafer at a rear surface of said semiconductor wafer;

measuring at least one of a voltage and a current applied to said wafer stage from said high frequency power supply;

obtaining an impedance from said semiconductor wafer to earth through a plasma, on the basis of a voltage value of said semiconductor wafer measured by a wafer voltage probe, and a voltage value or a current value measured by a current and voltage probe; and

performing a processing based on the obtained impedance.

28. A method of processing a semiconductor wafer, in a semiconductor manufacturing apparatus including a unit for generating a plasma in a vacuum chamber, a wafer stage for holding a semiconductor wafer introduced into said vacuum chamber, and a high frequency power supply for applying a high frequency voltage to said wafer stage, said method comprising the steps of:

measuring at least one of a voltage and a current applied to said wafer stage from said high frequency power supply;

obtaining an impedance at a position of a current and voltage probe on the basis of a voltage value or a current value measured by said current and voltage probe, and arithmetic processing a combined impedance of the obtained impedance and an equivalent

circuit model extending from said current and voltage probe to earth through said wafer stage, which equivalent circuit model being prepared beforehand, thereby to calculate an impedance from said semiconductor wafer to earth through the plasma; and performing a processing based on the calculated impedance.

29. A wafer voltage probe in a semiconductor manufacturing apparatus for processing a semiconductor wafer, comprising:

a contact needle having electrical conductivity and adapted to contact a rear surface of the semiconductor wafer to be measured;

a resilient member having electrical conductivity for supporting said contact needle; and

a current introducing terminal having a flange structure for supporting said resilient member,

wherein, a voltage of said contact needle is measurable from the atmospheric side, and a position of said contact needle in a height direction is adjustable from the atmospheric side.